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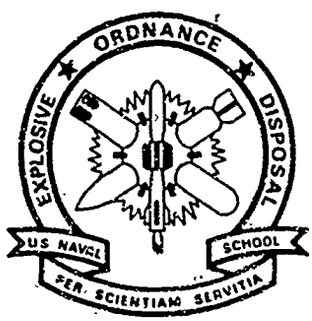
PSYCHOLOGICAL AND PHYSICAL PERFORMANCE CHARACTERISTICS OF SUCCESSFUL EXPLOSIVE ORDNANCE DIVER TECHNICIANS

Joyce Hogan, Ph.D.
Robert Hogan, Ph.D.

June, 1985



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This report describes the development of testing procedures to select students for Explosive Ordnance Disposal (EOD) training and thereby reduce attrition in this technical training speciality. In a longitudinal study of Navy EOD students (N=145), a battery of tests including a vocational preference measure, a personality measure, and a set of physical performance measures correlated .51, .47, and .61 respectively with second class diving certification, EOD course completion, and performance in the fleet. In a predictive validation study of

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Abstract

This report describes the development of testing procedures to select students for Explosive Ordnance Disposal (EOD) training and thereby reduce attrition in this technical training speciality. In a longitudinal study of Navy EOD students (N=145), a battery of tests including a vocational preference measure, a personality measure, and a set of physical performance measures correlated .51, .47, and .61 respectively with second class diving certification, EOD course completion, and performance in the fleet. In a predictive validation study of apprentice Army and Navy EOD students (N=179), a 44-item personality measure emphasizing elements of academic motivation, self-confidence, self-control, and self-sufficiency correlated .38 with successful course completion. The military cognitive measure, ASVAB, did not predict training performance in either study. Use of such validated measures for personnel selection should substantially alleviate attrition during both full and apprentice EOD training and also identify those who are likely to remain in EOD work subsequent to training.

Executive Summary

The overall goal of this project was to determine sources of attrition during the training of Explosive Ordnance Disposal technicians, and devise procedures for alleviating the attrition problem. Earlier reports document the fact that, for the Navy, attrition in EOD training occurs in three places: physical training prior to EOD school; diver training prior to EOD school; and training at EOD school.

The present report describes the development of procedures designed to select two kinds of trainees so as to minimize EOD attrition. The first are Navy volunteers; the second are volunteers from any service for the new EOD apprentice program.

With regard to the apprentice program, standard cognitive measures such as the ASVABs did not significantly predict performance during training. Conversely, a 44-item personality measure, emphasizing elements of academic motivation, self-confidence, self-control, working class values, and self-sufficiency, correlated .38 with the pass/fail criterion for a sample of 179 Army and Navy students in the apprentice EOD program.

With regard to the regular Navy EOD training program, the ASVABs were found once again to be uncorrelated with performance in diving training, EOD training, or on the job. Conversely, a battery of tests including a vocational preference measure, a personality measure, and a set of physical performance measures correlated .51, .47, and .61 with diving status, EOD training status, and performance as a fleet diver. Use of this battery will substantially alleviate attrition during regular Navy EOD training and also predict those who are likely to remain in EOD work subsequent to training.

I. Introduction

Attrition during technical training is a problem for all branches of the Armed Forces; the problem increases when the training programs are intensive, lengthy, and highly specialized. Attrition in Explosive Ordnance Disposal (EOD) training is no exception. This speciality requires volunteers to attend a 42 week course designed to provide them with the ability to locate, excavate, recover, identify, render safe, transport, and dispose of hazardous explosive ordnance. The training also includes instruction on operations in a nuclear, biological, or chemical contaminated environment. Historically, the program has tried to recruit personnel in their second enlistment and has used rigorous selection criteria. However, fewer people are volunteering for training and attrition rates have climbed, especially since E1s and E2s have begun to be admitted to the program. The shortage of skilled technicians in the senior enlisted personnel and petty officer ranks is of critical concern to the Navy (Allen, Chatelier, Clark & Sorenson, 1982). Although all services have had difficulties with retention, the Navy's personnel attrition problems are compounded by the diving certifications required by the speciality; the Navy's EOD technicians are also fully qualified as second class divers.

In order to meet the manpower requirements for trained EOD technicians, the Armed Forces have developed two alternative training program strategies. The first is a 12-week apprentice EOD program. Students in this program receive training in the major ordnance disposal course areas; in the field, however, they only assist fully qualified EOD technicians. A second strategy for reducing attrition in training is to

develop selection procedures designed to identify those volunteers most likely to complete the training course successfully. It is this area of selection for training that our research efforts address and that this report describes.

Traditional approaches to personnel selection for training focus on cognitive and technical aspects of the job. Screening guidelines for the EOD program include, as part of the initial review criteria, minimum scores on verbal and quantitative sections of the Armed Services Vocational Aptitude Battery (ASVAB: U.S. Department of Defense, 1980). Despite the fact that EOD classroom and field training are academically rigorous, ASVAB scores have not been very useful for predicting training completion (Alf & Gordon, 1957; Hall & Freda, 1982; Hogan, Hogan, & Briggs, 1984). There are, no doubt, numerous reasons for this including the restricted range of the ASVAB scores. However, even after using the appropriate corrections, the resulting correlations with training completion are only modest at best. This suggests that cognitive abilities are a necessary but insufficient criterion for performance in training. It becomes critical, therefore, to identify more effective predictors of program completion.

Some recent research has focused on certain non-cognitive aspects of jobs which seem critical for overall job performance (Hogan, Carpenter, Briggs, & Hansson, 1984). Non-cognitive measures include but are not limited to personality inventories, vocational preference measures, biographical inventories, adjective checklists, Q-sorts, attitude surveys, and interviews. Personality factors are often quite important for predicting job or training success particularly when technical competence needs are either minimal or assured through other selection standards.

For example using the Sixteen Personality Factor Questionnaire (16 PF), Cooper (1982) identified patterns of interpersonal/social behavior and orientation which predicted successful bomb disposal men. Successful technicians were described as social isolates prefering to work alone with "things" rather than with people. Similarly, Biersner and LaRocco (1983) studied the personality characteristics of "professional risk takers." They tested military divers using measures of locus of control, socialization, sensation seeking, and trait anxiety. Relative to nondivers, divers were characterized as socially autonomous, not anxious, and thrill, adventure, and sensation seeking.

Weybrew (1966) suggested twenty years ago that the field of military selection had spent too much time seeking psychopathological factors that degrade performance and too little time identifying positive factors that enhance performance; nonetheless, only a modest amount of research has studied attributes associated with the competent performance of hazardous duty. For example, Doll and Gunderson (1970) analyzed factors associated with performance in Antartic weather stations and found that personality-oriented behaviors were judged more important than task-oriented behaviors. Gunderson (1973) also found that the FIRO-B scales (Schutz, 1958) correlated with peer and supervisory ratings of task accomplishment and overall effectiveness in isolated work groups. Biersner and Hogan (1984) used a conceptually based personality measure to determine characteristics associated with adjustment to Antartic duty assignments. From self ratings and peer nominations, the results indicated that those who perform well have a low need for stimulation and a limited range of interests.

These results using personality inventories are consistent with

earlier research (Nelson, 1965; Taylor, 1978) regarding adjustment to isolated work conditions. Nelson described effective personnel as professionally competent, enthusiastic, friendly, and able to control socially disruptive emotions. Taylor characterized effective volunteers as competent, stable, and "relatively" compatible, noting that "those who cannot bear to be alone and those who cannot bear to be with others are likely to have difficulty when events occur that either leave them to their own devices or require them to support or encourage others" (p. 32). Similarly, persons with high needs for social interaction and challenge do poorly in isolated environments (Gunderson, 1966). In the same way, being interested in many hobbies and activities consistently predicts poor performance (Gunderson & Nelson, 1965). These results suggest that non-cognitive measures in general and personality inventories in particular are useful for identifying persons who can work effectively in hazardous or isolated environments.

The purpose of the research described in this report is to develop a means by which attrition in EOD training can be reduced. The research began by identifying those portions of the training program producing the highest attrition rates (Quigley & Hogan, 1982). Our subsequent research focused on developing methods for improving student selection. We emphasized non-cognitive predictors of performance both in training and on-the-job. The goal was to provide the EOD community with valid procedures for identifying persons with the motivation, and academic and physical qualifications necessary for this training and subsequent job performance. The final phase of the research is described in this report.

The overall project was organized in a series of cross-sectional and longitudinal studies. We first studied patterns of attrition in training

in order to determine where attrition was most likely to occur (Quigley & Hogan, 1982). We then studied psychological predictors of success in EOD training using a cross-sectional analysis (Hogan, Hogan, & Briggs, 1984). The current research is a longitudinal study that investigates the cognitive, non-cognitive, and physical performance factors associated with successful completion of second class diver training, apprentice EOD training, and EOD technician training. Finally, we analyzed psychological dimensions that characterize effective EOD technicians in the fleet. From this we developed three personnel selection test batteries:

(a) A psychological inventory for prospective EOD technicians

(b) A physical performance battery for prospective Navy second class divers

(c) A psychological inventory for prospective EOD apprentices

II. Objectives of the EOD Program

The EOD mission is to handle incidents involving explosive ordnance that pose real or potential threats to operations, installations, personnel, and/or material. Within each Service, EOD personnel are responsible operationally for carrying out the mission on specified installations and in assigned geographic areas. In addition, EOD personnel provide support to civil authorities when dangerous articles are reported in areas outside DOD installations. Such assistance may be either action or advice, but it is rendered by request from a federal or civil agency when required in the interest of public safety.

Training of EOD technicians is a joint services responsibility; one school provides technical training for all military EOD personnel. Portions of this training are conducted at various locations (e.g., Redstone Arsenal, Huntsville, AL.), but most is conducted by the Naval School, Explosive Ordnance Disposal at Indian Head, MD. The school is staffed with instructors from each service and each is also represented by liaison officers. Responsibility for training ultimately rests with the commanding officer of the Naval School.

The EOD training program conducted at the Naval School consists of a common core of courses for all Services as well as specialized courses required by individual services. Navy personnel volunteer for a 42 week course sequence that begins with diving training and ends with nuclear ordnance. The curriculum also includes courses in chemical/biological agents, core block (principles, explosives, fuses, effects, etc.), ground and projectile ordnance, demolition, air ordnance, underwater ordnance, and improvised explosive devices. Technical material is normally taught

using both conventional classroom lectures and field exercises. Students are evaluated on the basis of their understanding of course content as well as their ability to solve field problems. These evaluations result in students either passing or repeating courses (rollback). Successive rollbacks can result in academic dismissal. Other instances where students do not complete a course are termed medical or administrative drops or voluntary withdrawals.

This course of training is among the most academically demanding in the Armed Services. Successful course completion depends on cognitive, psychological, motivational, and vocational interest factors. In addition, Navy personnel must maintain a high level of physical fitness in order to complete diving and underwater ordnance training. It should, therefore, come as no surprise that student attrition is a problem. The importance of the job and the rigor of the training highlight the need to alleviate sources of attrition in the program.

The EOD training program is designed to meet the objectives necessary for effective field performance. The EOD operational program has a series of general objectives applicable to all services and specific operational objectives for each Service. The EOD Joint Service Regulation on Interservice EOD Responsibilities outlines these objectives.

"3. EOD Program Objectives

a. To insure the capability of the Services to perform their explosive ordnance disposal missions in assigned areas of responsibility. This includes emergency EOD support to other Services prior to their arrival on the scene.

b. To insure that operational capabilities of EOD organizations permit maximum interoperability of EOD forces in war and optimum mutual support in peace. The national goals to support this objective are outlined in attachment 1, however, each Service is responsible to determine the specific items required to support its mission.

4. EOD Mission. The EOD mission is to cope with EOD incidents which present a threat to operations, installations, personnel, or material.

5. Requisite Elements of Capability. The DOD EOD capability shall comprise, as a minimum, equipment, trained personnel and procedures to:

a. Exercise Control of EOD Operations. Control of EOD operations consists of operational control, planning and administrative services related to mission accomplishment of EOD units for assigned geographical areas of responsibility.

b. Augment EOD operations with Special Equipment and Personnel. Frequently, to complete their mission, EOD units will require augmentation of their organic resources by additional personnel and equipment.

c. Operate in a Nuclear, Biological or Chemical Contaminated Environment. In order to perform EOD access techniques and EOD procedures in an environment which has been contaminated by nuclear, biological or chemical weapons, EOD personnel must be specially trained and equipped to operate efficiently for extended periods in a contaminated environment with the highest possible degree of personal safety, manual dexterity, and freedom of body movement.

d. Perform Access Techniques and EOD Procedures. This capability is comprised of equipment, trained personnel and technical information required for the location, excavation, recovery, identification, performance of render safe procedures, transportation and disposal of UXO and hazardous EO.

e. Recover and Evaluate Enemy Explosive Ordnance for EOD and Intelligence Purposes. It is desirable that first-seen enemy explosive ordnance be rendered safe non-destructively, recovered, evaluated from the standpoint of EOD and turned over to a technical intelligence team for further exploitation from an intelligence standpoint. On this type of EO a photographic (and radiographic, if necessary) record of the explosive ordnance must be made, and EOD procedures and all descriptive data recorded.

f. Provide for an Interchange of Information between EOD and Technical Intelligence Agencies. EOD operations must support a two-way flow of information on explosive ordnance between technical intelligence and EOD.

g. Develop New EOD Procedures, Tools and Equipment for First-Seen Enemy Explosive Ordnance. Specially qualified perfonnel, facilities and equipment must be available to develop EOD procedures, tools, and equipment.

h. Train EOD Personnel in EOD Procedures, Tools and Equipment. A composite of initial qualification of individuals, team qualification and recurring refresher training programs for individuals and units.

i. Inspect and Evaluate EOD Units. A system of instection and evaluation of the ability of an EOD element to perform their assigned

mission with maximum proficiency.

6. Responsibilities

a. Service Operational Responsibilities: Operational EOD responsibilities are:

(1) U.S. Army:

(a) On army installations, or for EO in the physical possession of the Army.

(b) On the land mass areas except for those specifically assigned as a responsibility of the Navy, Marine Corps or Air Force as established in subparagraphs 2, 3 and 4 below.

(c) In conjunction with Civil Defense agencies and civil authorities, the establishment, operation and support of an Explosive Ordnance Reconnaissance (EOR) system on land masses.

(d) Primary point of contact for the U.S. Secret Service for all EOD support for Presidential, and other VIP protection. The Secret Service and the Army may request EOD assistance from other Services for such support.

(2) U.S. Navy:

(a) On Navy installations or for EO in physical possession of the Navy, and in assigned operational areas.

(b) Within the oceans and contiguous waters, up to the high water mark of sea coasts, inlets, bays, harbors, and rivers.

(c) In any rivers, canals or enclosed bodies of water.

(d) Rendering safe and disposal of underwater explosive ordnance.

(3) U.S. Marine Corps:

On Marine Corps installations, or for EO in the physical possession of the Marine Corps, or in assigned operational areas.

(4) U.S. Air Force:

On Air Force installations, at dispersal bases (which include non-DOD installations from which Air National Guard and Air Reserve Forces operate), in assigned operational areas, and for EO in the physical possession of the Air Force.

(5) EOD operational responsibilities include, when requested, assistance by one Service to another.

(6) It is the responsibility of the Service that first becomes

aware of an EOD incident involving explosive ordnance of another service or Federal Agency, regardless of location, to take action to prevent or limit damage or injury and currently to notify the responsible Service.

b. EOD Support to Civil Authorities:

Rendering safe and disposing of non-nuclear improvised explosive devices; non-military commercial explosives, or similar dangerous articles reported or discovered in areas outside DOD installations are normally responsibilities of civil authorities. These tasks are not normally the responsibility of Service EOD personnel. EOD assistance, in the form of EOD actions and/or advice, may be provided upon request from federal agencies or civil authorities at any level, when a determination has been made by the Service concerned that such assistance is required or desirable in the interest of public safety."

III. Predicting Success as an EOD Technician

This study investigates the correlates of successful completion of the 42-week EOD training program. Navy students (N=97) completed a comprehensive battery of psychological, physical, and vocational interest measures one day prior to the beginning of training. These students were followed until they graduated, withdrew, or were dropped from the program. Of these students, 54 graduated, and 43 failed to complete the course, yielding an attrition rate of 44%. Data were also collected on students who completed second class diver certification. Finally, a group of incumbent EOD technicians (N=48) were tested with the psychological battery and performance evaluations from their supervisors were gathered. Statistical analyses were computed to determine predictors of diving, EOD training, and job performance criteria. Methods and results of these studies are presented in this section.

Method

Beginning June 6, 1983 and continuing through FY84, all Navy enlisted personnel entering EOD training completed an extensive test battery to be described below. These students (N=97) were all male, and ranged in age from 18 to 33 years. Ninety students were white, and seven were black. All volunteered to participate in the testing and none received additional compensation. All students were tested one day prior to the beginning of second class diver training. Students were then followed to the end of the program. Three criterion scores were recorded for each student: (1) whether or not they achieved second class diving certification; (2) whether or not they completed the EOD course; and (3) the number of times they were required to repeat a specific phase of training. These criteria

were labelled "diving success", "course success", and "rollbacks", respectively.

Predictors

The predictor battery included four classes of measures -- personality, vocational interests, cognitive, and physical performance. The personality measure, the Hogan Personality Inventory (HPI; Hogan, 1983, 1985) predicted EOD course success in an earlier cross-sectional study of students from all services (Hogan, Hogan, & Briggs, 1984). The HPI assesses six factors associated with status and popularity in everyday life; these are: Intellectance (bright vs. dull); Adjustment (high vs. low self-esteem); Prudence (conscientious vs. irresponsible); Ambition (energetic and leaderlike vs. anergic and passive); Sociability (extraverted vs. introverted); and Likeability (agreeable vs. disagreeable). These six factors form the primary scales each of which contains between 23 and 52 items. Each scale is composed of smaller units or subscales called Homogenous Item Composites (HICs); statistical analyses can be computed at the HIC level as well as the scale level. The HPI has been useful for predicting job performance in private sector organizations (see Hogan, 1985) as well as specialized military occupations (Biersner & Hogan, 1984; Hogan, Hogan, & Briggs, 1984).

Vocational interests were assessed using the Self-Directed Search (SDS; Holland, 1972) which is a widely used vocational preference measure. The SDS categorizes interests in terms of six occupational themes or types, and results from combining these types identifies the occupations an individual would find most interesting. We used the SDS to identify those personnel whose vocational interests were incompatable with EOD work.

The Armed Services Vocational Aptitude Battery (ASVAB; U.S. Department of Defense, 1980) is the primary cognitive test battery used by the Armed Forces. We requested scores on two subscales, Word Knowledge (WK) and Arithmetic Reasoning (AR), from personnel files as individuals reported for duty.

Finally, we administered an extensive series of physical performance tests which integrates several well-known physical fitness test batteries and includes measures found useful for predicting occupational performances. Although a variety of physical measures could be used as predictors, we choose tests that could be categorized on a conceptual basis. We identified seven dimensions that provide a comprehensive coverage of the physical performance domain, and we used the following four criteria: (1) recognized research history as a component of a relevant taxonomy; (2) definition consistent with human physiological categories; (3) measurement yielding adequate variability across individuals; and (4) potential to account for variability in performance of multiple tasks. The seven dimensions of performance are Muscular Tension, Muscular Power, Muscular Endurance, Cardiovascular Endurance, Flexibility, Balance, and Neuromuscular Coordination. These dimensions are defined in Figure 1. A discussion of the conceptual model can be found in Hogan (1984) and an example application is provided by Denning (1984) in a test validation study of a multi-plant manufacturing industry. To study EOD training attrition, we used twenty-six physical tests--23 performance tests and 3 anthropometric measures--in the experimental test battery. These included measures from five widely known physical fitness test batteries -- AAHPERD (1976) Youth Fitness Test, AAHPERD (1980) Health Related Fitness Tests, Cooper's (1968) field test of aerobic capacity,

Figure 1

Physical Performance Dimensions, Definitions, and Tests

Physical Performance Dimension	Physical Tests
Muscular Strength The capacity to exert force as a result of tension produced in muscles	Hand Grip[4,3,5] Static Pull Static Lift
Muscular Power The capacity to exert force to move a mass a given distance during a measured time.	Medicine Ball Throw[4] Shuttle Run[2,4] Standing Long Jump[2] 50 Yd. Dash[2,5] Vertical Jump
Muscular Endurance The capacity of muscles to continue work over time while resisting fatigue	Push Ups Pull Ups[2,4,5] Sit Ups[1,2] Arm Ergometer
Cardiovascular Endurance The capacity of the heart and related body systems to sustain prolonged muscular activity	1 Mile Run[1,5] 1½ Mile Run[3] 600 Yd. Run[2,4,] 300 Yd. Swim Underwater Swim
Flexibility The full range of motion through which a limb, limb segment or lever arm can rotate	Sit and Reach[1] Trunk Twist[4]
Balance The maintenance of body stability	Balance Rail[4] Rolling Board
Neuromuscular Coordination The capacity to organize movements in sequence within temporal and spatial constraints as a response to either internal or external stimuli	Cable Jump[4] Speeded Twist & Bend[4]
Physical Measures	Skinfold[1] Height Weight

[1]American Alliance for Health, Physical Education, Recreation and Dance, (1980). Lifetime health related physical fitness. Reston, VA: AAHPERD.

[2]American Alliance for Health, Physical Education, Recreation and Dance, (1976). Youth fitness test manual. Reston, VA: AAHPERD.

[3]Cooper, K. H. (1968). Aerobics. New York: Bantam Books.

[4]Fleishman, E. A. (1964). The structure and measurement of physical fitness. Englewood Cliffs, NJ: Prentice-Hall.

[5]International Committee for the Standardization of Physical Fitness Tests (1974). Leonard Larson, (Editor). Fitness, health, and work capacity: International standards for assessment. NY: MacMillan.

Fleishman's (1964) Basic Fitness Tests, and the ICSPFT (1974) Basic Physical Performance Tests. These tests, the batteries from which they are drawn, and the physical performance dimension intended to be measured appear in Figure 1; the relative effectiveness of these batteries for predicting physical training success is described by Hogan (1985). We included some additional tests in the experimental battery on the basis of their previous success in test validation research.

Beyond the tests representing the seven physical performance dimensions, three anthropometric measures and a manual dexterity test were included. The anthropometric measures were height, weight, and skinfold. Skinfold measures were assessed using electronic calipers (Skyndex; Skyndex Corporation) programmed to calculate percent body fat based on the Durnin formula (Durnin & Womersly, 1974). Results from this formula correlate significantly with underwater weighing results and the formula seems more accurate than the Sloan (Sloan, 1967; Sloan, Burt & Blyth, 1962), Jackson-Pollock (Jackson, Pollock & Ward, 1978), and Brozeck-Keys (Brozeck, Grande, Anderson & Keys, 1963) formulae which tend to underestimate body fat by 3 to 4%. We chose the Purdue Pegboard (Tiffin, 1960) to measure manual dexterity, based on its ease of administration and extensive normative data. All test descriptions appear in Appendix A and the variable labels and scoring units appear in Appendix B.

Criteria

Seven criterion measures were used as indicators of performance in EOD training and performance as a fleet diver. Five of these criteria were discrete measures of pass/fail or status within the EOD community. The final two criteria were subjective performance ratings provided by E-7 and E-8 level supervisory personnel.

The five objective criteria are defined below:

(1) Diving Success: Pass/Fail training in second class diving; Pass coded "1" and Fail coded "0".

(2) Course Success: Pass/Fail 42 week EOD training course; Pass coded "1" and Fail coded "0".

(3) Rollback: Repeat a phase of training due to academic, administrative, or medical problems; coded by number of occurances "4" = No rollbacks, "3" = 1 rollback; "2" = 2 rollbacks; "1" = 3 rollbacks.

(4) Diving Status: Organizational level as a diver; Fail diving coded "0", Pass diving coded "1", current fleet diver coded "2".

(5) EOD Status: Organizatonal Level as an EOD technician; Fail EOD course coded "0", Pass EOD course coded "1", Current fleet EOD technician coded "2".

In addition to the five objective measures, two subjective evaluations were obtained. The first was a rating of overall EOD potential obtained at the conclusion of the diving phase of training. Overall EOD potential was defined and a seven-point rating scale was provided. Scale anchors ranged from 1, indicating a student's potential was poor, to 7, indicating a student's potential was excellent. Two CPO instructors independently provided ratings for each student at the completion of the diving phase of training. The interrater reliability was calculated for these ratings and the resulting coefficient was .84, indicating adequate agreement on students' EOD potential. This measure was labelled "CPO Rating". The second rated criterion was an evaluation of the performance of incumbent fleet EOD technicians. We asked CPOs to

nominate a group of current divers who were regarded in the fleet as "excellent" performers and to nominate a group of current divers who were regarded as "average" EOD technicians. The "excellent" technicians were given a score of "1" and the "average" technicians were given a score of "0". This criterion measure was labelled, "Fleet EOD Rank."

Procedure

Student subjects were tested over the course of one day with a two hour break mid-day. All paper and pencil tests were administered to entire classes as a group. The physical performance tests were administered to groups of five to seven individuals. Three test administrators trained to use standardized test procedures were responsible for conducting several different tests. Students rotated among the test stations. As a group, subjects completed warm-up exercises prior to testing sessions. All subjects wore athletic clothes and athletic shoes; boots were not permitted.

Results

Results based on the paper and pencil tests are presented first, then the results of the physical performance tests are described. The emphasis here is on the validity results; descriptive statistics can be found in Appendix C and earlier technical reports (see Hogan, Hogan, & Briggs, 1984).

Sample Descriptions: Vocational interests and personality characteristics were assessed with the SDS (Holland, 1972) and the HPI (Hogan, 1985), respectively. On the SDS, EOD students received their highest scores for Realistic, Investigative, and Social interests. This pattern of scores characterizes engineers, technicians, or perhaps athletes. Such persons are conventional, unsociable, technically

oriented, and masculine. They are also curious, helpful, and physically active. It follows that persons who deviate markedly from this profile (i.e. persons with Artistic interests) will be dissatisfied with EOD training and therefore will be at risk for attrition. On the HPI, students received their highest scores for Intellectance, Adjustment, and Likeability while they received their lowest scores for Prudence. As a group these individuals are bright, self-assured and agreeable, but rambunctious.

Validity Analyses. Table 1 presents the first set of results concerning the predictors of performance during EOD training. This table contains correlations between ASVAB scales, the SDS scales and four criterion measures based on the longitudinal sample of EOD students (N=97). In terms of predicting performance from cognitive tests, neither the verbal (WK) or quantitative (AR) scales of the ASVAB were significantly related to success in diving, EOD course completion, or CPO ratings. On the SDS, one of the six scales was correlated with several criteria. Realistic interests were significantly related to success in diving training, in EOD training, and to CPO's ratings for overall potential as an EOD technician.

Table 2 presents the results using measures of personality. These correlations are based on the samples of 97 EOD students and the 48 current EOD fleet technicians. This table contains correlations between HPI HICs -- the small item composites that make up the six larger scales -- and selected criteria associated with success on the job. Diving success and EOD course success incorporate both training and job performance. EOD rank reflects performance as a fleet technician. There are a number of significant HIC criterion relationships which range from

Table 1

Correlations Between SDS/ASVAB Predictors and

EOD Course Success

Predictor	Diving Success (N=83)	Rollback[a]	Course Success (N=83)	CPO Rating (N=75)
ASVAB - WK (N=63)	.01	.15	.10	.20
ASVAB - AR (N=63)	.05	-.08	.06	-.05
SDS - Realistic	.21*	.05	.25**	.24*
SDS - Investigative	.17	-.16	.17	.16
SDS - Artistic	.01	-.22	-.17	-.17
SDS - Social	-.05	-.09	-.14	-.09
SDS - Enterprising	-.02	.00	-.12	-.09
SDS - Conventional	-.01	-.10	-.14	-.01

Note:

[a]N's ranged from 38 to 50
*$p < .05$
**$p < .01$

Table 2

Correlations of HPI HICs with EOD Criterion Measures

HPI HIC Predictor	Diving Success (N=144)	EOD Course Success (N=144)	EOD Rank (N=48)
Memory	.01	.04	-.05
School Success	.00	.03	-.21
Math Ability	.05	-.02	-.02
Science Ability	.10	.14*	-.29*
Reading	-.02	-.08	-.21
Cultural Taste	-.13	-.15*	-.28*
Curiosity	.14*	.08	.00
Intellectual Games	.05	-.01	.00
Not Anxious	.10	.05	-.16
No Social Anxiety	.05	-.00	-.03
No Guilt	-.07	-.06	.10
Not Depressed	.17*	.19**	-.11
No Somatic Complaint	.05	.09	-.23*
Calmness	.02	.00	-.15
Self Confidence	.22**	.18*	.02
Identity	.02	-.03	.09
Self Focus	.03	.03	-.03
Good Attachment	-.12	-.14*	.05
Structure/Planfulness	-.27**	-.34**	-.06
Appearance	-.10	-.14*	.00
Mastery/Hard Work	-.07	-.10	.10
Perfect	-.13	-.13	-.02
Impulse Control	-.30**	-.30**	-.18
Avoids Trouble	-.04	-.03	-.16
Experience Seeking	-.17*	-.08	-.01
Thrill Seeking	.16*	.22**	.28*
Not Spontaneous	-.22**	-.23**	-.06
Generates Ideas	.09	.09	-.12
Leadership	.06	.06	.25*
Status	-.04	-.05	.21
Impression Mgt	-.02	-.02	-.06
Competitive	.09	.06	.26*
Entertaining	.30**	.26**	-.14
Exhibitionistic	.14*	.12	-.26*
Likes Crowds	-.25**	-.22**	-.26*
Likes Parties	-.01	.02	.10
Expressive	-.02	-.04	.14
Easy to Live With	-.16*	-.16*	-.12
Even Tempered	.02	.02	-.15
Caring	-.05	-.06	-.20
Trusting	-.01	.04	.07
Likes People	-.06	-.05	-.12
Autonomy	-.06	-.08	-.01

Note: *p < .05; one-tailed test
**p < .01; one-tailed test

.30 to -.34. Although many of these simple r's are modest, they are interpretable particularly when examined across criteria. Success in diving training was readily predictable; 13 HICs were correlated with this outcome. Diving training is a major source of attrition in EOD training, and the results in Table 2 are an important contribution to solving this problem. The results suggest that persons who pass diver training are curious, self-confident, spontaneous, impulsive, but socially withdrawn. Success in EOD school was also readily predicted by a set of 13 HICs. These were similar to the HICs associated with success in diving training, and characterize the successful EOD student as bright, practical, non-conforming, impulsive, even rowdy, and somewhat prickly. This pattern of HICs associated with actual performance as an EOD technician in the fleet was rather different. Well regarded fleet technicians are more conforming, more ambitious and more leaderlike than students; they prefer to work alone, and curiously, they are characterized by somatic complaints--perhaps to worry about their health is useful in these circumstances.

Subsequent HPI analyses were targeted at developing measures of overall performance potential for EOD technicians. Because of the number of possible predictors from the HPI (43 HICs) and the sample size (N=145), precautions were taken to minimize the effects of chance in the data analysis. HICs comprising the final selection instruments were selected on conceptual grounds rather than on the basis of pure empirical validity. We focused on the pattern of prediction across the major criterion measures and the final HICs chosen for the measure of overall potential for EOD work included: Science Ability, Not-Depressed, Self-Confidence, Leadership, Not Thrill Seeking, Competitive, Likes Crowds,

Structure/Planfulness, and Impulse Control. The HICs for Likes Crowds, Structure/Planfulness, and Impulse Control were reverse scored due to their negative relationship to the criteria. These HICs represent facets of the Intellectance, Adjustment, Prudence, Ambition, and Sociability Scales of the HPI. The final selection battery uses a unit weighted summation of scores on the nine selected HICs rather than regression weights, which would capitalize on the idiosyncracies of this particular sample.

The 48 items from the nine HICs were combined to form the EOD Potential Inventory (EODPI). A copy of this inventory appears in Appendix D and hit rate expectancies at various score cutoffs appear in Appendix E. The EODPI was correlated with the seven criterion measures and these are presented in Table 3 (see page 17 for the definition of the terms in Table 3). As can be seen, four correlations are significant, and the strongest relationship is between the EODPI and EOD status ($r = .48$, $p < .01$). The stability of the relationships for diving and EOD status was estimated by splitting the sample roughly in half according to each criterion and correlating the predictor and criterion measures for each half. These results are also presented in Table 3 and the confirm the stability of the original total group finding.

Descriptive statistics for the EODPI and the seven criterion measures along with the intercorrelations between the criterion measures are presented in Table 4. As can be seen, all criteria are significantly ($p < .01$) interrelated. The relationship between diving success and course success, diving status, and EOD status are expected since diving success is a component of the latter measures. CPO's ratings of overall EOD potential correlated rather highly with the other criteria, which is not

Table 3

Correlations between EODPI and Seven Criterion Measures for Total Sample

Scale	Diving Success	Course Success	Rollback	CPO Rating	EOD Rank	Diving Status	EOD Status
EODPI	.12 (N=97) P=.12	.22 (N=97) P=.01	-.11 (N=57) P=.20	.10 (N=89) P=.18	.35 (N=48) P=.00	.44 (N=145) P=.00	.48 (N=145) P=.00

Correlations between EODPI and Status Criteria for Sample Halves

Scale	Diving Status	EOD Status
EODPI (N=72)	.42 (N=72) P=.00	.50 (N=72) P=.00
EODPI (N=73)	.49 (N=73) P=.00	.47 (N=73) P=.00

Table 4

Descriptive Statistics for EODPI and Criterion Measures

and Intercorrelations between Criterion Measures

Variable	$\bar{x}$	s.d.	Minimum	Maximum	N
EODPI	31.83	4.62	17.0	42.0	145

Variable	$\bar{x}$	s.d.	Minimum	Maximum	N
Diving Success	.79	.41	0.0	1.0	97
Course Success	.56	.50	0.0	1.0	97
Rollback	3.26	.92	1.0	4.0	57
C.P.O. Rating	4.94	1.42	1.0	7.0	89
Fleet EOD Rank	1.52	.50	1.0	2.0	48
Diving Status	1.19	.66	0.0	2.0	145
EOD Status	1.03	.79	0.0	2.0	145

Variable	2	3	4	5	6	7
Diving Success	.57	.99	.61	--	1.00	.57
Course Success		.29	.52	--	.57	1.00
Rollback			.43	--	.99	.29
C.P.O. Rating				--	.62	.52
Fleet EOD Rank					1.00	1.00
Diving Status						.89
EOD Status						

Note: All correlations are significant at the $p < .01$ level.

surprising given the raters' familiarity both with students' performance and requirements of EOD technicians, in general. The fact that rollbacks are only modestly related to course success is somewhat surprising. One might think that course repetitions would be strongly associated with course failure; however, the descriptive statistics indicate that among those students who survive the early phases of training (i.e., do not withdraw and are not dropped), there is an average of .74 rollbacks per student -- that is nearly one rollback for each individual over the duration of the program. Although there appears to be substantial redundancy in this set of criterion data, each measure serves a conceptual purpose and relates to specific operational training and job outcomes.

Since the research sample contained insufficient numbers for race and sex subgroup analyses, the EODPI was used to score HPI protocols in our archival sample. The various individual samples that are included in the overall archival file are described in Hogan (1985). In lieu of an actual applicant sample from the Armed Services, it appeared that this archival sample could reasonably approximate the expected relevant applicant pool. The results of scoring the archival sample on the EODPI appear by subgroup in Table 5. Across subgroups, scores ranged between 18 and 47 out of a possible 48 item inventory. Scores occurring at the designated percentiles varied only by one point across subgroups with the exception of the scores for blacks at the 25th percentile. We examined mean sex and race difference EODPI scores and although statistical differences emerged due to the large sample sizes, these differences of approximately one scale score have little practical significance.

Table 6 presents a third set of results concerning the physical performance predictors of EOD training. This table contains correlations

Table 5

EOD Potential Inventory Score Means,

Standard Deviations and Percentiles for HPI

Archival Race and Sex Subgroups

	Total	Sex		Race	
Statistic	(N=2291)	Female (N=590)	Male (N=1637)	White (N=1154)	Black (N=253)
EODPI					
Mean	34.44	35.07	34.17	35.08	34.00
sd	4.99	4.94	4.99	4.77	4.91
Minimum	18	18	18	18	18
Maximum	47	45	47	46	45
25%	31	31	30	31	29
50%	34	35	34	35	35
75%	38	38	37	38	37

Table 6

Correlations of Physical Performance Tests and Selected EOD Course Criterion Measures

Physical Performance Predictor	Diving Success (N=97)	Course Success (N=97)	Petty Officers' Rating (N=89)	Rollback (N=57)
1. 1.5 Mile Run	-.20*	-.14	-.16	-.02
2. 300 yd. swim[a]	-.17	-.06	-.31*	-.30
3. Underwater swim[b]	.23	.00	.09	-.09
4. Grip strength	.09	.04	.16	.25*
5. Pull strength	.21*	.11	.14	.02
6. Lift strength	.23**	.32**	.31*	.10
7. Medicine ball throw	.33**	.26**	.28**	.23*
8. Push-ups	.13	-.02	.29**	.20
9. Pull-ups	.14	.09	.17	.02
10. Arm ergometer	.36**	.21*	.34**	.22
11. Shuttle run	-.11	.08	-.39**	-.17
12. Long jump	.09	.03	.33**	.34*
13. 50 yd. dash	.00	-.02	.15	.28*
14. Vertical jump	.23**	.22*	.19*	.04
15. Cable jump	.13	.04	.17	.29*
16. Sit-ups	.24**	.11	.28**	.05
17. Twist & bend	.22*	.04	.30**	.18
18. Sit & reach	-.02	.01	.08	-.01
19. Trunk twist	.10	.00	.14	-.13
20. Rolling board	.14	.22*	.09	-.20
21. Balance rail	.03	.11	.13	.08
22. Purdue Pegboard RLB	.18*	.13	.03	.10
23. Purdue pegboard assembly	.13	.05	.14	.26*
24. Weight	.16	.17	.12	.03
25. Height	.15	.10	.24*	.24*
26. Percent fat	-.11	-.14	-.29**	-.20

Note: [a]N=45
[b]N=20
*$p < .05$
**$p < .01$

between 26 physical performance tests and four course criterion measures. A number of these tests are significantly related to the criteria and the magnitude of these correlations ranges from .18 to -.39 (the correlation is negative since this is a speeded test). Rather than predicting performance on the basis of a single test or simply using those tests with significant validity coefficients, we constructed a battery based on the physical constructs that formed a conceptual structure for performance (see Figure 1). Using these seven constructs, we identified tests with the best pattern of prediction across the four criteria. Our major emphasis, however, was on significant predictors of diving success and course success. The physical test battery consisted of Lift Strength, Medicine Ball Throw, Arm Ergometer, 1-1/2 Mile Run, Twist & Bend, Rolling Board, and Purdue Pegboard Assembly Test. The resulting multiple R for predicting diving success was .49 and for predicting course success was .43. For cross validation purposes, we split the sample roughly in half based on the criterion score, and recomputed the multiple correlation for each sample half. The resulting R's of the seven physical tests for predicting diving success were .39 and .66; the resulting R's for predicting course success were .52 and .41. This suggests that the multiple Rs based on the total sample are not artifacts of the data set and do not shrink dramatically as a result of a more conservative analysis.

In order to test the relationships among the construct measures of the physical performance model (see Hogan, 1984), we intercorrelated test scores from the battery and these correlations are presented in Table 7. As can be seen, tests of the three muscular constructs were significantly related, tests of cardiovascular and muscular endurance were significantly

Table 7

Intercorrelations and Factor Analysis of Physical Performance Tests Included in Final Predictor Battery

(N=129)

Variable	2	3	4	5	6	7
1. Arm Ergometer	-.28**	.10	.37**	.00	.14	.15*
2. 1½ Mi Run		.08	-.19**	-.07	.06	-.13
3. Lift Strength			.35**	.02	-.04	.00
4. Medicine Ball Throw				.09	.16*	.01
5. Rolling Board					.02	-.02
6. Purdue Pegboard (Assembly)						.12
7. Twist & Bend						

Variable	Factor 1	Factor 2	Factor 3	Factor 4
Lift Strength	.82	-.15	-.11	-.08
Medicine Ball Throw	.76	.31	.15	.15
1.5 Mile Run	.06	-.85	.15	-.11
Arm Ergometer	.38	.63	.25	-.07
Purdue Pegboard Assembly	.08	-.12	.89	.11
Twist & Bend	-.15	.38	.50	-.24
Rolling Board	.01	.04	.02	.95

related, and tests of flexibility, balance, and neuromuscular coordination are generally independent of other tests. Not expected, however, was the moderate correlation between the cardiovascular endurance test and the muscular power test. Data in the intercorrelation matrix were factor analyzed using the principal components method and the factors were rotated to an orthogonal varimax criterion of simple structure (SPSS, Inc., 1983). Four factors emerged with eigenvalues greater than 1.0 which accounted for 68% of the variance in the matrix. These results are also presented in Table 7. Factor 1 is a general strength factor characterized by tests of isometric strength as well as dynamic (isotonic) strength. Factor 2 is an endurance dimension defined by the tests of both muscular and cardiovascular endurance. The third factor is general neuromuscular dimension that encompasses both fine motor manipulative actions as well as gross motor (twist & bend) involvement. Factor 4 is defined as balance. These results can be interpreted as support for the hypothesized relationships among the physical constructs.

One final analysis was computed to determine the amount of variance in criterion performance that could be accounted for by test performance. Independent measures included vocational interests, personality, and physical performance test scores. Specifically, we regressed the SDS-Realistic Scale, FODPI, and the seven physical performance tests against three criterion measures. The resulting multiple R's were .51, .47, and .61, for the diving success, course success, and diving status criteria, respectively. This indicates that the combined tests account for between 22 and 37 percent of the variance in criterion performance depending on the criterion outcome of interest.

Discussion

There are four points about these analyses that can be emphasized. First, individuals who are likely to succeed in EOD training and continue as divers in the fleet have practical and concrete interests (SDS-Realistic Scale) and, although somewhat introverted, are well-adjusted, self-confident, and risk-taking. They like working on technical problems and they don't mind working alone. Individuals who are uninterested in technology and who are not sufficiently self-assured for hazardous work, will not perform well either in EOD training or on the job.

Second, these data reflect on the merits of noncognitive measures for predicting training performance. In situations where the variance in cognitive measures is restricted, their validity will be reduced or will disappear. In the latter case, one cannot correct a nonsignificant validity coefficient, so we are left without a selection device. Moreover one could argue that even if significant validity coefficients were obtained, the prediction would be at the low end of test performance. That is, low ASVAB scores predict poor performance in training. However, do higher ASVAB scores predict success in training? The Navy's 44% attrition rate in EOD training after screening out low ASVAB scoring personnel suggests not. There are alternatives to the use of cognitive measures for personnel selection and these appear to work reasonably well for predicting academic training performance.

Third, the physical performance test scores were significantly related to both diving success and course success. This is important for the Navy because the diving and the underwater ordnance phases of training account for approximately 35% of the overall attrition in training. The

battery that is recommended is conceptually sound as well as easily administered requiring only a short period of time.

Finally, if all these selection procedures are combined, the resulting performance prediction is substantial. It should be noted that no statistical corrections of any sort have been used to compute the results. This suggests that the findings reported here are conservative and underestimate true validities of the selection tests.

IV. Predicting Success as an Apprentice EOD Technician

The Armed Services conduct 12-week apprentice EOD training programs designed to fill the EOD manpower requirements of the operating detachments. Their programs were instituted because attrition in the 42-week EOD training program could potentially create manpower shortages over time. This 12-week course was instituted in order to train personnel to assist fully qualified EOD technicians. The program trains students in major ordnance disposal curriculum areas and, in addition, Navy students are required to complete a five week scuba diving course. Although there appears to be a reasonable flow of volunteers for this training, attrition is a problem for the apprentice program and its current rate is approximately 42%.

Given the costly and unique nature of EOD training, a personnel selection procedure designed to maximize the probability for successful completion of training was developed to address the problematic attrition rate. Vocational interests, cognitive predictors, and personality factors were studied to determine their potential value in EOD apprentice selection. The selection test battery was developed using a predictive validation strategy.

Method

Subjects. Subjects in this study were Army (N=119) and Navy (N=60) students enrolled in the U.S. Army Missile and Munitions Center and School (Redstone Arsenal) and the Naval Diving and Salvage Training Center (Panama City), respectively. These students included 155 males and 24 females ranging in age from 17 to 35 years. Acceptance to the EOD training program was based on the present Armed Forces' screening

procedures which included: the candidate's voluntary application, interviews, and ASVAB test results.

Instruments. The predictive battery administered to the students included: the Hogan Personality Inventory (HPI; Hogan, 1985); the Self-Directed Search (SDS; Holland, 1972); and the Armed Services Vocational Aptitude Battery (ASVAB; U.S. Department of Defense, 1980). Each of these instruments is discussed more fully in Section III above.

Procedure. All subjects were administered the test battery immediately prior to the first day of EOD apprentice training. Tests were administered to classes at the beginning of each session. New classes were begun at regular intervals from August 1983 to August 1984. ASVAB scores were obtained from each individual's service record.

Successful completion (Pass) and failure to complete (Fail) the EOD training program were used as criteria for the predictive analysis. Criterion data were collected from official records on individual students at the end of each class session (approximately 12 weeks). Those individuals who successfully completed training were assigned a score of "1" and those who failed to complete training for any reason were assigned a score of score of "0". These criterion scores were recorded for all students.

Results.

The first set of results concerns the characteristics of the average apprentice trainee. On Holland's SDS these students are characterized by high scores on the Realistic, Investigative, and Social scales which suggest they are practical, concrete, technically oriented, and prefer working with other people. Scores for the HPI indicate that the average trainee is well adjusted, bright, and gets along well with people. This

average trainee profile does not differ significantly from an expected HPI profile for an average individual in the population at large. Moreover, HPI scale scores on the six personality dimensions are not significantly different for the total groups of Army and Navy trainees. Descriptive statistics for these samples appear in Appendix F. In terms of criterion performance, 73 of the 119 Army students passed the training program and 31 of the 60 Navy students completed training.

Table 8 presents the second set of results concerning the HPI predictors of performance during EOD training. A number of significant personality variables were associated with completion of training by Army personnel. The HICs Autonomy, Not Depressed, Competitive, Not Spontaneous, Not Anxious and, Likes People show a positive relationship; Structure/Planfulness and Status Seeking reflect a negative relationship with the Pass/Fail criterion. The magnitude of these relationships varied between .15 and .28. HPI results concerning predictors of successful course completion by Navy students also appear in Table 8. The best single predictor was the HIC Not Spontaneous (r=.37) followed by Mastery (r=.28), Easy to Live with (r=.25) and Identity (r=.25). Although the only significant HIC common to both Army and Navy samples was Not Spontaneous, correlations for Not Anxious, Avoids Trouble, and Autonomy approached significance in both samples. Therefore, we combined these two samples (N=179) to compute overall correlations applicable for both groups. These results -- correlations between HICs and course completion -- also appear in Table 8. As can be seen, the best pattern of prediction was achieved with HICs for Autonomy, Not Spontaneous, Not Anxious, Not Depressed, and Structure/Planfulness, and the resulting multiple R was .38.

Table 8

Correlations between HPI HICs and Course Completion Criterion Measures for EOD Apprentice Training

	Criteria		
HPI HIC Predictor	Army EOD Pass/Fail (N=119)	Navy EOD Pass/Fail (N=60)	All EOD Pass/Fail (N=179)
Memory	.11	.03	.09
School Success	.07	.07	-.02
Math Ability	-.01	.10	.02
Science Ability	.06	-.01	.05
Reading	.12	-.02	.09
Cultural Taste	-.11	.08	-.05
Curiosity	.09	.09	.10
Intellectual Games	.04	-.24*	-.03
Not Anxious	.15*	.22	.17*
No Social Anxiety	-.02	-.02	-.03
No Guilt	-.01	.17	.03
Not Depressed	.23**	-.15	.15*
No Somatic Complaint	.11	-.03	.06
Calmness	.12	.14	.11
Self Confidence	.14	.07	.11
Identity	.06	.25*	.11
Self Focus	-.02	-.08	-.04
Good Attachment	-.12	.07	-.06
Structure/Planfulness	-.16*	.21	-.17*
Appearance	-.13	.02	-.07
Mastery/Hard Work	.04	.28*	.11
Perfect	-.03	-.05	-.03
Impulse Control	.10	.08	.09
Avoids Trouble	.14	.20	.17*
Experience Seeking	-.11	.05	-.07
Thrill Seeking	-.02	-.14	-.03
Not Spontaneous	.17*	.37**	.19**
Generates Ideas	-.03	-.08	-.04
Leadership	-.02	.02	-.01
Status	-.15*	.17	-.15*
Impression Mgt	.08	-.02	.05
Competitive	.16*	.00	.10
Entertaining	-.01	.00	.01
Exhibitionistic	-.04	-.06	-.03
Likes Crowds	-.12	-.13	-.12
Likes Parties	-.03	-.05	-.03
Expressive	.06	-.14	.01
Easy to Live With	.03	.25*	.09
Even Tempered	.10	.10	.08
Caring	.10	.16	.12
Trusting	.02	-.05	-.00
Likes People	.19*	-.12	.10
Autonomy	.28**	.19	.26**

*p < .05

**p < .01

A final set of nine HICs were assembled and given unit weights to form the EOD Apprentice Potential Index (EODAPI). HICs were not simply chosen for their empirical validity, rather the scale was conceptually based. HICs representing all scales except Sociability were included. Intellectance HICs for Good Memory and Reading should be associated with academic performance during training; Adjustment HICs for Not Anxious and Not Depressed will reflect self-confidence, self assurance, and a positive disposition toward life. Not Spontaneous and Avoids Trouble from the Prudence scale will provide students who respond well to rules and authority while Structure/Planfulness (reverse scored) will be associated with flexibility. On the Ambition scale, persons scoring high on Status Seeking (reverse scored) will be complacent and unconcerned with upward mobility. Finally, on the Likeability scale, persons who score high on Autonomy will be independent and will not mind working with minimal social interaction. These nine HICs provide 44 items for the EODAPI and these are contained in Appendix G. The simple correlation between the EODAPI and the pass/fail criterion measure for the total sample (N=179) was .32. Mean differences comparing EODAPI scores over the pass group and the fail group evaluated by means of a t-test indicated significant ($p < .01$) group differences.

Since the research sample included only small numbers of females and blacks, the EODAPI was used to score HPI protocols in our archival sample. This sample provides adequate numbers of individuals for analyses of possible race (black vs. white) and sex differences. The individual research samples included in the archival file are described in Hogan (1985). These samples are almost exclusively employed adults with no overt psychopathology. Results of scoring the archival sample on EODAPI

appear by subgroup in Table 9. Across subgroups, scores ranged from 11 to 42 on a possible 44-item inventory. Mean scores for race and sex subgroups varied only by approximately one scale score. This was also the case for mean percentile cutoff scores at the 75th, 50th, and 25th percentiles with the exception of the 25th percentile where women, on the average, scored 2 points higher than men. Although all of these subgroup differences are statistically different, a one-point scale score difference between subgroups represents no practical score difference in application.

A third set of analyses focused on the relationship between SDS and ASVAB scores and course completion. Table 10 presents these results for each sample separately and the samples combined. As can be seen neither vocational interests nor cognitive measures were useful for predicting performance in apprentice training. Although the Army relies on composite ASVAB scales and the Navy uses single scales, neither appear useful as screening criteria for apprentice training. As indicated in Section III, the problem is more than one of statistical range restriction given the level of attrition from the program.

Finally, if a selection procedure consisting only of the EODAPI were implemented as an apprentice program screening device, the concern for establishing cut-off scores would arise. We calculated the probabilities of successfully completing apprentice training based on EODAPI predictor scores and pass/fail criterion data for the total research sample (N=179). The results appear in Table 11 based on five point EODAPI scale intervals. Based on the research sample data. If individuals score 36 or above on the scale, they have a 100% chance of successfully completing the training program. Of those individuals whose scores fell in the interval between

Table 9

EOD Apprentice Potential Inventory Score Means,

Standard Deviations and Percentiles for HPI

Archival Race and Sex Subgroups

		SEX		RACE	
Statistic	Total (N=2291)	Female (N=590)	Male N=1637)	White (N=1154)	Black (N=253)
EODAPI					
Mean	27.2	28.2	26.9	28.0	27.0
sd	4.9	4.7	4.9	4.6	4.6
Minimum	11.0	12.0	11.0	13.0	15.0
Maximum	42.0	42.0	39.0	42.0	38.0
25%	24.0	25.0	23.0	24.0	23.0
50%	27.0	28.0	27.0	28.0	27.0
75%	30.0	31.0	30.0	31.0	30.0

Table 10

Correlations between SDS, ASVAB Scores and with EOD Apprentice Course Success

Predictor	Criterion Measure: Army EOD Pass/Fail (N=119)	Navy EOD Pass/Fail (N=60)	All EOD Pass/Fail (N=170)
SDS - Realistic	.04	-.11	-.06
SDS - Investigative	.02	-.22	.00
SDS - Artistic	-.02	.06	.06
SDS - Social	.06	.01	.09
SDS - Enterprising	-.04	-.09	-.03
SDS - Conventional	.11	-.20	.08
ASVAB - AGM	.07	--	--
ASVAB - AGT	.05	--	--
ASVAB - WK	--	.12	--
ASVAB - AR	--	-.15	--

Note: All $p > .05$

Table 11

Expectancies for EOD Apprentice Training

Success at Various Test Score Intervals

EODAPI Score	Training Success	
	Pass	Fail
1-17	33.3%	66.7%
18-23	39%	61%
24-29	67.1%	32.9%
30-35	82.9%	17.1%
36-42	100%	0%

24 and 29 on the EODAPI, two-thirds of them completed training. Although there are many factors that influence the use of cut-off scores, this kind of information can be helpful when cut-offs scores are deemed necessary.

Discussion

The results of this study support the premise that personality measures can be used to predict successful completion of technical training. The failure of traditional cognitive measures such as the ASVAB to provide valuable predictive information for EOD training was clearly demonstrated. These findings have important implications for EOD technician selection procedures as well as other high risk technical occupations. They indicate that non-technical aspects of job and training performance are as crucial to overall prformance as the technical aspects.

The ability to identify the successful candidate can be enhanced by understanding the personality profile associated with such successful performance. The EOD candidate who successfully completed training is bright, dependable, and self-confident, but has few needs for social involvement and can work alone effectively. A successful trainee will have to be intellectually capable of progressing through training; however cognitive talents alone will not suffice.

Rachman (1978, 1983) emphasized the importance of training with respect to later on-the-job performance. Training was seen as providing the appropriate skills required in dangerous bomb disposal incidents. Training also facilitated courageous behavior because it seemed to reduce estimates of danger and increased self-confidence. Such a strong link between training and performance on the job increases the importance of proper selection for training. The element of self-confidence as a determinant of success is apparent in the relationship between Autonomy

and Pass/Fail which represented the strongest single predictor in the study of apprentice EOD trainees.

V. Conclusions

Attrition during technical training courses continues to be a problem for a military system that increasingly relies on high technology. Traditional goals of military instruction include, on one hand educating individuals to fully qualified status, and on the other hand processing students through the program efficiently. When attained, each of these goals translates into increased training efficiency and reduced training costs. To avoid problems of training attrition, increasing emphasis has been placed on the development of instructional technology. The proliferation of computers in uses ranging from computer-assisted instruction to hand-held performance aids, is but one attempt to counter the problems associated with excessive training time and attrition.

In addition to these instruction innovations, however, it is necessary to attend to personnel selection factors for technical training. Most research concerning the training of job knowledge and skills is designed to determine main effects of various treatment interventions. In their state-of-the-art review, Wheaton, Rose, Fingerman, Korotkin, and Holding (1976) conclude that, "little is known about how rate of learning and transfer of training are influenced by interactions among task characteristics, training device design, trainee attributes and training techniques. Until these components are thoroughly explored and documented, the problem of designing an effective training system, in other than on a trial and error basis, will remain unresolved" (p. 2). Unfortunately, ten years later Wexley (1984) notes the absence of individual difference assessments in training research, and recommends investigations of individual factors associated with training performance.

The current study approached the problem of attrition in technical

training by constructing personnel selection procedures from individual differences measures. We were concerned with answering three questions. First, what kind of Navy student is likely to complete diver training and be certified as a second class diver? Second, what kind of person is likely to complete explosive ordnance disposal training? And third, what kind of person will perform well at the actual job of bomb disposal technician? Although one might suspect that individual differences in training and job performance could be accounted for by learning rates or cognitive measures, our cross-sectional studies suggest that the ASVABS are not particularly useful (Hogan, Hogan, & Briggs, 1984). Instead we used vocational interests, personality, and physical performance measures as experimental variables in a predictive validation strategy.

From correlations with training outcome measures, we can describe the successful diver trainee as someone who is well-adjusted, physically self-confident, open to experience, but a loner and an introvert. He also exhibits a generally high level of physical fitness and can perform activities that require both short and extended bouts of muscular activity as well as localized and gross body aerobic work. The pattern of correlations is much the same for those who complete EOD training, in part because those who failed diving also failed the EOD course, although among successful EOD trainees there is also an emphasis on spontaneity, rowdiness and introversion. These students are, in addition, practical, technically oriented, and masculine. On the other hand, well regarded EOD technicians working in the fleet are more cautious and conforming than EOD students, less interested in science, but equally introverted.

The results support four conclusions. First, performance as a bomb technician is largely a function of the Prudence scale of the HPI, which

emphasizes planfulness, impulse control, caution, and flexibility. Conversely, EOD performance seems to have nothing to do with the Ambition scale of the HPI with which there are not significant correlations in the analysis. Second, it appears that schooling and on the job performance are only moderately related, in the sense that only some of the qualities related to successful performance in training are also related to successful performance in the field. In some cases, in fact (e.g., Exhibitionistic), these qualities are actually opposed to one another. Third, it is worth noting that the HPI worked in the sense that it was able to discriminate between persons successfully completing training as a Navy bomb technician and persons who dropped out of training; it also discriminated between persons who perform well on the job (as determined by supervisor's ratings) and persons whose performance is judged to be merely adequate. This point is worthy of note because no other assessment device did so discriminate, and this includes the military's cognitive measures. Finally, stress proneness or stress resistance was largely irrelevant in these analyses.

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Appendix A

Description and References for Physical Tests

The skinfold measurement is assessed with the Skyndex electronic calipers at the biceps, tricepts, subscapulae, and illiac crest, using the Durnin formula. The final score is the percentage of total body weight that is fat (AAHPERD, 1980).

The Purdue Pegboard is a commercially manufactured test of manual dexterity, consisting of the manipulation of pins, collars, and washers on a pegboard with the right hand, left hand and both hands. Scoring consists of the number of pins inserted in the pegboard within the 30 or 60 second time limit (Tiffin, 1960).

The balance rail is a measure of static balance requiring the individual to balance with one foot on a 3/4" rail, hands on hips, and eyes closed. Scoring is the amount of time (to the nearest tenth of a second) that the balance can be maintained on two separate trials (Fleishman, 1964).

The rolling board is a measure of balance; the participant must stand on the board that is straddled over a short log. Each of the two trials begins when the person is balanced, and is timed in seconds until either side of the board touches the ground.

The speeded twist and bend tests neuromuscular coordination. The participant stands with back to the wall, and alternates touching the floor between the feet, then straightening up and twisting around to touch an "X" marked on the wall behind the back at shoulder blade height. The score is the number of times the participant touches the wall in 20 seconds (Fleishman, 1964).

The trunk twist assesses trunk flexibility, requiring the participant to stand with one side to the horizontal chart on the wall, arms at shoulder height, and to rotate clockwise as far as possible. The score of both trials is recorded in inches; a 180° twist is read as 12 inches, greater rotation results in a higher score (Fleishman, 1964).

Grip strength is measured using a Smedley grip dynometer. Scores of both trials are measured in kilograms using the dominant hand, (Fleishman, 1964, ICSPFT, 1974).

The pull test measures muscular strength. It is administered using a Dillan Dynamometer chained to an immovable post at waist height. Participants are positioned correctly to exert a maximum horizontal pull on the dynamometer handle. Each of the three pulls is recorded to the nearest 10 pounds (Hogan, Zonderman, & Pederson, 1981).

The lift test is a measure of static strength. The participant is instructed to use proper lifting techniques and exert a maximum vertical pull against the handle and dynometer anchored to a platform. The three pulls are recorded to the nearest 10 pounds (Hogan, Zonderman, & Pederson, 1981).

The standing long jump assesses muscular power of the legs. The participant jumps as far as possible from a standing start in each of three trials. Score is the distance jumped (in inches) from the take off line to the point of contact of the heels (AAPHERD, 1976).

The medicine ball throw tests muscular power. The participant stands with both feet on the ground and throws a 18 lb. ball as far as possible, using one hand (shot-put style). The score for each of three trials is read in inches from the measuring tape secured to the ground (Fleishman, 1964).

The cable jump assesses neuromuscular control by requiring the participant to jump over a length of rope held between the hands. The score is the number of successful jumps computed in five trials (Fleishman, 1964).

The pull-up measures muscular endurance of the upper body. The participant uses an overhand grasp to perform as many consecutive chin-ups as possible (AAPHERD, 1976; Fleishman, 1964; and ICSPFT, 1974).

Modified sit-ups which assess abdominal strength and endurance are performed with bent knees, and arms crossed over the chest. Scoring is the number of sit-ups completed in 60 seconds (AAPHERD, 1980; AAPHERD, 1976).

The arm ergometer test measures upper body endurance by requiring the participant to crank two handles set at a resistence of 50 watts. The score is the number of revolutions completed in 90 seconds (Hogan, Jennings, Ogden, & Fleishman, 1980).

The vertical jump measures the distance between standing reach and maximum height jumped in 3 trials. Muscular power is determined from a nomogram based on inches jumped and body weight (ICSPFT, 1974; Mathews & Fox, 1976).

The sit and reach test is a measure of flexibility in the lower back and legs. From a sitting position the participant stretches forward and reaches along a meter stick; 0 cm is even with the knees, and 23 cm is even with the feet (AAPHERD, 1980).

Push-ups are a measure of upper body endurance. Scoring is the number of correct push-ups (feet, hips and shoulders lined up) performed consecutively (Robertson, 1982).

The shuttle run is a measure of muscular power. The participant must run 30 feet, pick up a block, turn, run back, put it down and then repeat again as quickly as possible. Each of the two trials is timed to the nearest tenth of a second (AAPHERD, 1976; Fleishman, 1964).

The 50 yard dash assesses explosive strength and power. From a standing start, both trials are timed to the nearest tenth of a second (AAPHERD, 1976; ICSPFT, 1974).

The 1½ mile, 1 mile and 600 yard run each measure cardiovascular endurance. One trial is given for each distance; time is recorded to the nearest second (AAPHERD, 1980; AAPHERD, 1976; Cooper, 1968; Fleishman, 1964; ICSPFT; 1974).

The 300 yard swim assesses cardiovascular endurance, requiring the participant to cover the 12 lengths of a 25 yard pool as quickly as possible.

The underwater swim is a measure of anaerobic capacity. Each participants pushes off the wall and swims as far as possible underwater. The markers along the side of the pool (measured in feet) are used to determine the total number of yards swum.

Appendix B

Physical Testing Variables and Scoring Units

Physical Testing Variables

Fitness Test	Units of Measurement	Computed Score
1 Mile Run	Min.	Trial 1
1-1/2 Mile Run	Min.	Trial 1
600 Yd. Run	Min.	Trial 1
300 Yd. Swim	Min.	Trial 1
Underswim	Yds.	Trial 1
Grip Str.	Kg.	(Trial 1 + 2) /2
Pull Str.	lbs.	(Trial 1 + 2+ 3) /3
Lift Str.	lbs.	(Trial 1 + 2 + 3) /3
Med. Ball	Inches	(Trial 1 + 2) /2
Push-up	Number	Trial 1
Pull-up	Number	Trial 1
Arm Ergom.	Number	Trial 1
Shuttle Run	Sec.	(Trial 1 + 2) /2
Long Jump	Inches	(Trial 1 + 2 + 3) /3
50 Yd. Dash	Sec.	(Trial 1 + 2) /2
Vert. Jump	Inches	(Trial 1 + 2 + 3) /3
Cable Jump	Number	(Trial 1 + 2 + 3 + 4 + 5)
Sit-ups	Number	Trial 1
Twist Bend	Number	Trial 1
Sit & Reach	Cm.	(Trial 3 + 4) /2
Trunk Twist	Inches	(Trial 1 + 2) /2
Balroll	Sec.	(Trial 1 + 2) /2
Balrail	Sec.	(Trial 1 + 2) /2
Weight	lbs.	Trial 1
Height	Inches	Trial 1
Pct /Fat	Percent	Trial 1

Appendix C

Descriptive Statistics for HPI and Physical Performance Test Results

HPI Descriptive Statistics: Students

Passing EOD Course

VARIABLE	MEAN	STD DEV	MINIMUM	MAXIMUM	VALID N
GOOD MEMORY	3.111	1.633	0.0	5.000	54
SCHOOL SUCCESS	1.907	1.103	0.0	3.000	54
MATH ABILITY	2.407	1.643	0.0	4.000	54
READING	1.963	1.479	0.0	4.000	54
SCIENCE ABILITY	4.796	1.172	1.000	6.000	54
CULTURAL TASTE	2.093	1.307	0.0	4.000	54
CURIOSITY	2.426	.767	1.000	3.000	54
INTELLECTUAL GAMES	2.278	1.089	0.0	4.000	54
NOT ANXIOUS	2.093	1.307	0.0	4.000	54
NO SOCIAL ANXIETY	3.741	1.905	0.0	6.000	54
NO GUILT	3.667	1.853	0.0	6.000	54
NOT DEPRESSED	5.537	.794	3.000	6.000	54
NO SOMATIC COMPLAINT	5.630	.653	4.000	6.000	54
CALMNESS	3.278	.856	1.000	4.000	54
SELF CONFIDENCE	2.519	.720	0.0	3.000	54
IDENTITY	4.981	1.434	0.0	6.000	54
SELF-FOCUS	1.870	1.360	0.0	5.000	54
GOOD ATTACHMENT	3.130	1.874	0.0	6.000	54
STRUCTURE / PLANFULNESS	2.667	1.303	0.0	5.000	54
APPEARANCE	2.315	1.301	0.0	4.000	54
MASTERY / HARDWORK	3.556	.925	1.000	5.000	54
PERFECT	1.944	1.323	0.0	5.000	54
IMPULSE CONTROL	2.537	1.734	0.0	6.000	54
AVOIDS TROUBLE	4.407	1.838	1.000	7.000	54
EXPERIENCE SEEKING	.759	.867	0.0	4.000	54
THRILL-SEEKING	.648	.731	0.0	3.000	54
NOT SPONTANEOUS	2.333	1.099	0.0	4.000	54
GENERATES IDEAS	3.222	1.475	0.0	5.000	54
LEADERSHIP	4.815	2.173	0.0	7.000	54
STATUS	3.759	1.386	0.0	5.000	54
IMPRESSION MANAGEMENT	2.870	1.705	0.0	6.000	54
COMPETITIVE	4.630	.560	3.000	5.000	54
ENTERTAINING	1.315	1.130	0.0	4.000	54
EXHIBITIONISTIC	2.185	1.543	0.0	5.000	54
LIKES CROWDS	1.537	1.370	0.0	4.000	54
LIKES PARTIES	1.944	1.235	0.0	4.000	54
EXPRESSIVE	2.444	1.327	0.0	5.000	54
EASY TO LIVE WITH	4.685	.843	1.000	5.000	54
EVEN TEMPERED	4.093	1.783	0.0	6.000	54
CARING	3.685	.609	2.000	4.000	54
TRUSTING	1.852	.960	0.0	3.000	54
LIKES PEOPLE	5.241	.989	2.000	6.000	54
AUTONOMY	2.056	1.338	0.0	4.000	54
INFREQUENT RESPONSE	15.463	.946	12.000	16.000	54
INTELLECTANCE	20.981	5.989	9.000	31.000	54
ADJUSTMENT	33.315	7.478	16.000	45.000	54
PRUDENCE	24.296	6.649	13.000	39.000	54
AMBITION	19.296	4.487	6.000	27.000	54
SOCIABILITY	9.426	3.864	2.000	16.000	54
LIKEABILITY	21.611	3.662	13.000	26.000	54
VALIDITY	15.463	.946	12.000	16.000	54

HPI Descriptive Statistics: Students

Failing EOD Course

VARIABLE	MEAN	STD DEV	MINIMUM	MAXIMUM	VALID N
GOOD MEMORY	3.070	1.549	0.0	5.000	43
SCHOOL SUCCESS	1.628	1.155	0.0	3.000	43
MATH ABILITY	1.907	1.525	0.0	4.000	43
READING	1.930	1.486	0.0	4.000	43
SCIENCE ABILITY	4.279	1.420	1.000	6.000	43
CULTURAL TASTE	2.233	1.288	0.0	4.000	43
CURIOSITY	2.279	.825	0.0	3.000	43
INTELLECTUAL GAMES	2.023	1.336	0.0	4.000	43
NOT ANXIOUS	2.186	1.367	0.0	4.000	43
NO SOCIAL ANXIETY	4.372	1.633	0.0	6.000	43
NO GUILT	3.651	1.646	0.0	6.000	43
NOT DEPRESSED	5.256	1.002	2.000	6.000	43
NO SOMATIC COMPLAINT	5.233	1.020	2.000	6.000	43
CALMNESS	3.419	.852	0.0	4.000	43
SELF CONFIDENCE	2.372	.846	0.0	3.000	43
IDENTITY	5.070	1.334	1.000	6.000	43
SELF-FOCUS	1.814	1.332	0.0	5.000	43
GOOD ATTACHMENT	3.651	1.837	0.0	6.000	43
STRUCTURE / PLANFULNESS	3.000	1.496	0.0	5.000	43
APPEARANCE	2.953	1.068	1.000	4.000	43
MASTERY / HARDWORK	3.558	1.119	1.000	5.000	43
PERFECT	2.163	1.045	0.0	4.000	43
IMPULSE CONTROL	2.977	1.611	0.0	6.000	43
AVOIDS TROUBLE	4.442	1.868	1.000	7.000	43
EXPERIENCE SEEKING	.860	1.265	0.0	4.000	43
THRILL-SEEKING	.628	.787	0.0	3.000	43
NOT SPONTANEOUS	2.744	.954	1.000	4.000	43
GENERATES IDEAS	3.186	1.468	0.0	5.000	43
LEADERSHIP	5.238	1.694	2.000	7.000	42
STATUS	3.512	1.009	1.000	5.000	43
IMPRESSION MANAGEMENT	2.907	1.477	0.0	6.000	43
COMPETITIVE	4.442	.765	2.000	5.000	43
ENTERTAINING	1.256	1.049	0.0	4.000	43
EXHIBITIONISTIC	2.581	1.451	0.0	5.000	43
LIKES CROWDS	1.837	1.430	0.0	4.000	43
LIKES PARTIES	2.233	1.377	0.0	5.000	43
EXPRESSIVE	2.674	1.340	0.0	5.000	43
EASY TO LIVE WITH	4.744	.727	1.000	5.000	43
EVEN TEMPERED	4.186	1.562	1.000	6.000	43
CARING	3.674	.566	2.000	4.000	43
TRUSTING	1.698	1.036	0.0	3.000	43
LIKES PEOPLE	5.093	1.231	1.000	6.000	43
AUTONOMY	1.977	1.225	0.0	4.000	43
INFREQUENT RESPONSE	15.395	1.137	11.000	16.000	43
INTELLECTANCE	19.349	6.301	7.000	30.000	43
ADJUSTMENT	33.372	6.932	16.000	43.000	43
PRUDENCE	26.977	5.527	16.000	38.000	43
AMBITION	19.163	3.651	12.000	26.000	43
SOCIABILITY	10.581	4.055	3.000	19.000	43
LIKEABILITY	21.372	3.792	13.000	27.000	43
VALIDITY	15.395	1.137	11.000	16.000	43

HPI Descriptive Statistics: Current EOD

Technicians Rated High for Job Performance

VARIABLE	MEAN	STD DEV	MINIMUM	MAXIMUM	VALID N
GOOD MEMORY	3.160	1.375	0.0	5.000	25
SCHOOL SUCCESS	1.520	1.194	0.0	3.000	25
MATH ABILITY	1.800	1.607	0.0	4.000	25
SCIENCE ABILITY	4.400	1.291	2.000	6.000	25
READING	1.360	1.440	0.0	4.000	25
CULTURAL TASTE	1.440	1.121	0.0	4.000	25
CURIOSITY	2.440	.651	1.000	3.000	25
INTELLECTUAL GAMES	2.000	1.258	0.0	4.000	25
NOT ANXIOUS	2.160	1.214	0.0	4.000	25
NO SOCIAL ANXIETY	4.280	1.768	0.0	6.000	25
NO GUILT	3.560	1.805	0.0	6.000	25
NOT DEPRESSED	5.600	.866	3.000	6.000	25
NO SOMATIC COMPLAINT	5.240	.970	3.000	6.000	25
CALMNESS	3.320	.690	2.000	4.000	25
SELF CONFIDENCE	2.720	.614	1.000	3.000	25
IDENTITY	5.080	1.412	2.000	6.000	25
SELF-FOCUS	1.880	1.394	0.0	5.000	25
GOOD ATTACHMENT	3.080	1.552	0.0	6.000	25
STRUCTURE / PLANFULNESS	1.720	1.100	0.0	4.000	25
APPEARANCE	2.480	1.085	0.0	4.000	25
MASTERY / HARDWORK	3.400	1.225	0.0	5.000	25
PERFECT	1.720	1.275	0.0	4.000	25
IMPULSE COMTROL	1.440	1.446	0.0	5.000	25
AVOIDS TROUBLE	4.040	1.399	1.000	7.000	25
EXPERIENCE SEEKING	.640	.860	0.0	3.000	25
THRILL-SEEKING	1.560	1.710	0.0	6.000	25
NOT SPONTANEOUS	2.040	1.020	0.0	4.000	25
GENERATES IDEAS	3.360	1.350	0.0	5.000	25
LEADERSHIP	5.960	1.620	0.0	7.000	25
STATUS	3.640	1.381	1.000	5.000	25
IMPRESSION MANAGEMENT	2.720	1.745	0.0	6.000	25
COMPETITIVE	4.720	.458	4.000	5.000	25
ENTERTAINING	1.840	1.068	0.0	4.000	25
EXHIBITIONISTIC	2.680	1.435	0.0	5.000	25
LIKES CROWDS	.800	1.041	0.0	3.000	25
LIKES PARTIES	2.400	1.384	0.0	5.000	25
EXPRESSIVE	2.720	1.621	0.0	5.000	25
EASY TO LIVE WITH	4.320	1.069	1.000	5.000	25
EVEN TEMPERED	4.080	1.320	1.000	6.000	25
CARING	3.440	.870	1.000	4.000	25
TRUSTING	1.880	1.054	0.0	3.000	25
LIKES PEOPLE	4.760	1.786	0.0	6.000	25
AUTONOMY	1.720	1.137	0.0	4.000	25
INFREQUENT RESPONSE	14.920	1.038	13.000	16.000	25
INTELLECTANCE	18.120	5.622	10.000	28.000	25
ADJUSTMENT	33.840	6.681	14.000	42.000	25
PRUDENCE	22.120	5.960	13.000	35.000	25
AMBITION	20.400	4.153	10.000	27.000	25
SOCIABILITY	10.440	3.595	3.000	17.000	25
LIKEABILITY	20.200	4.555	10.000	25.000	25
VALIDITY	14.920	1.038	13.000	16.000	25

HPI Descriptive Statistics: Current EOD

Technicians Rated Average for Job Performance

VARIABLE	MEAN	STD DEV	MINIMUM	MAXIMUM	VALID N
GOOD MEMORY	3.304	1.663	0.0	5.000	23
SCHOOL SUCCESS	1.957	.767	0.0	3.000	23
MATH ABILITY	1.870	1.740	0.0	4.000	23
SCIENCE ABILITY	5.130	1.140	2.000	6.000	23
READING	1.957	1.397	0.0	4.000	23
CULTURAL TASTE	2.087	1.125	0.0	4.000	23
CURIOSITY	2.435	.662	1.000	3.000	23
INTELLECTUAL GAMES	2.000	1.044	0.0	4.000	23
NOT ANXIOUS	2.565	1.343	0.0	4.000	23
NO SOCIAL ANXIETY	4.391	1.924	0.0	6.000	23
NO GUILT	3.174	2.125	0.0	6.000	23
NOT DEPRESSED	5.783	.850	2.000	6.000	23
NO SOMATIC COMPLAINT	5.652	.775	3.000	6.000	23
CALMNESS	3.522	.665	2.000	4.000	23
SELF CONFIDENCE	2.696	.765	0.0	3.000	23
IDENTITY	4.826	1.337	2.000	6.000	23
SELF-FOCUS	1.957	1.397	0.0	5.000	23
GOOD ATTACHMENT	2.913	2.130	0.0	6.000	23
STRUCTURE / PLANFULNESS	1.870	1.217	0.0	4.000	23
APPEARANCE	2.478	1.592	0.0	4.000	23
MASTERY / HARDWORK	3.087	1.832	0.0	5.000	23
PERFECT	1.783	1.536	0.0	5.000	23
IMPULSE CONTROL	1.957	1.522	0.0	5.000	23
AVOIDS TROUBLE	4.565	1.830	1.000	7.000	23
EXPERIENCE SEEKING	.652	.935	0.0	3.000	23
THRILL-SEEKING	.783	.850	0.0	3.000	23
NOT SPONTANEOUS	2.174	1.267	0.0	4.000	23
GENERATES IDEAS	3.652	1.071	2.000	5.000	23
LEADERSHIP	5.000	2.089	0.0	7.000	23
STATUS	3.087	1.240	0.0	5.000	23
IMPRESSION MANAGEMENT	2.913	1.535	0.0	5.000	23
COMPETITIVE	4.348	.885	2.000	5.000	23
ENTERTAINING	2.130	1.058	0.0	4.000	23
EXHIBITIONISTIC	3.391	1.196	1.000	5.000	23
LIKES CROWDS	1.391	1.158	0.0	3.000	23
LIKES PARTIES	2.130	1.254	0.0	4.000	23
EXPRESSIVE	2.304	1.329	0.0	5.000	23
EASY TO LIVE WITH	4.522	.511	4.000	5.000	23
EVEN TEMPERED	4.478	1.275	2.000	6.000	23
CARING	3.739	.541	2.000	4.000	23
TRUSTING	1.739	1.010	0.0	3.000	23
LIKES PEOPLE	5.130	1.140	2.000	6.000	23
AUTONOMY	1.739	1.389	0.0	4.000	23
INFREQUENT RESPONSE	14.826	1.586	10.000	16.000	23
INTELLECTANCE	20.739	4.901	12.000	29.000	23
ADJUSTMENT	34.565	6.266	20.000	46.000	23
PRUDENCE	22.261	8.572	5.000	40.000	23
AMBITION	19.000	4.758	7.000	25.000	23
SOCIABILITY	11.348	3.311	6.000	17.000	23
LIKEABILITY	21.348	2.994	16.000	27.000	23
VALIDITY	14.826	1.586	10.000	16.000	23

Physical Performance Test Descriptive Statistics:

Students Passing Second Class Diving Course

VARIABLE	MEAN	STD DEV	MINIMUM	MAXIMUM	VALID N
1.5 MILE RUN	650.529	78.116	497.000	932.000	70
300 YARD SWIM	387.829	45.036	282.000	464.000	35
UNDERWATER SWIM	27.143	7.523	15.000	40.000	14
GRIP STRENGTH	60.314	7.167	47.500	78.500	70
PULL STRENGTH	160.167	31.134	80.000	243.333	70
LIFT STRENGTH	378.524	70.912	260.000	710.000	70
MEDICINE BALL THROW	270.773	39.035	201.000	378.000	66
PUSH-UPS	78.771	25.513	29.000	155.000	70
PULL-UPS	12.214	3.978	4.000	30.000	70
ARM ERGOMETER	220.565	22.691	166.000	294.000	69
SHUTTLE RUN	106.100	8.415	89.000	124.000	70
LONG JUMP	85.636	10.450	60.333	103.667	54
50 YARD DASH	65.779	6.081	51.000	82.000	70
VERTICAL JUMP	7269.164	1167.770	4409.667	10795.667	71
CABLE JUMP	4.371	1.144	0.0	5.000	70
SIT-UPS	52.171	7.122	38.000	66.000	70
TWIST AND BEND	17.400	2.595	12.000	23.000	70
SIT AND REACH	33.971	7.770	5.500	51.000	70
TRUNK TWIST	16.343	6.287	0.0	27.000	70
ROLLING BOARD	124.586	258.155	12.500	1276.000	70
BALANCE RAIL	23.214	8.105	10.500	56.000	70
PURDUE PEGBOARD RLB	47.471	6.520	36.000	65.000	70
PURDUE PEGBOARD ASSEMBLY	35.169	5.690	22.000	46.000	71
WEIGHT	170.300	18.702	133.000	214.000	70
HEIGHT	70.579	2.852	62.500	77.000	70
PERCENT FAT	144.780	33.889	42.000	225.000	59

Physical Performance Test Descriptive Statistics:

Students Failing Second Class Diving Course

VARIABLE	MEAN	STD DEV	MINIMUM	MAXIMUM	VALID N
1.5 MILE RUN	691.105	94.466	525.000	884.000	19
300 YARD SWIM	406.700	49.333	337.000	495.000	10
UNDERWATER SWIM	23.333	8.756	10.000	30.000	6
GRIP STRENGTH	58.632	7.877	39.000	69.500	19
PULL STRENGTH	144.737	25.804	100.000	213.333	19
LIFT STRENGTH	337.982	67.480	220.000	476.667	19
MEDICINE BALL THROW	238.412	29.644	156.000	282.000	17
PUSH-UPS	69.632	35.312	31.000	169.000	19
PULL-UPS	10.842	4.682	2.000	20.000	19
ARM ERGOMETER	199.421	21.469	150.000	231.000	19
SHUTTLE RUN	108.553	10.670	89.500	126.000	19
LONG JUMP	83.156	11.660	69.333	104.667	15
50 YARD DASH	65.711	8.415	54.500	89.000	19
VERTICAL JUMP	6605.807	981.496	4024.000	8341.000	19
CABLE JUMP	3.947	1.870	0.0	5.000	19
SIT-UPS	47.632	8.668	35.000	67.000	19
TWIST AND BEND	15.947	2.915	11.000	21.000	19
SIT AND REACH	34.263	5.731	26.000	45.000	19
TRUNK TWIST	14.763	6.299	.500	22.500	19
ROLLING BOARD	47.026	48.321	8.000	216.500	19
BALANCE RAIL	22.605	7.619	10.000	42.500	19
PURDUE PEGBOARD RLB	44.579	6.131	35.000	57.000	19
PURDUE PEGBOARD ASSEMBLY	33.316	6.532	19.000	47.000	19
WEIGHT	162.474	20.315	124.000	210.000	19
HEIGHT	69.521	2.743	65.500	74.000	19
PERCENT FAT	156.500	65.220	41.000	294.000	16

Appendix D

EOD Potential Inventory (EODPI)

EOD Potential Inventory

(EODPI)

1. I think crowded public events (rock concerts, sports events) are very exciting.
2. I would like to work with high explosives.
3. I am a leader in my group.
4. I would like to learn scuba diving.
5. I have a natural talent for influencing people.
6. I am a very self-confident person.
7. It bothers me when my daily routine is interrupted.
8. I would enjoy sky-diving.
9. It is exciting to be part of a large crowd.
10. Most of the time I am proud of myself.
11. I get away with alot of things.
12. I don't like things to be uncertain and unpredictable.
13. The future seems hopeless to me.
14. Nothing good ever happens to me.
15. I won't start a project unless I know how it will turn out.
16. I sometimes have too much to drink.
17. I tend to give up when I meet difficult problems.
18. I like to do things on the spur of the moment.
19. I set high standards for myself.
20. It is always best to stick with a plan that works.
21. I am a follower, not a leader.
22. I get depressed a lot.
23. I have taken things apart just to see how they work
24. I would like to be a racecar driver.

25. It often seems that my life has no meaning.
26. I think I would like to do research.
27. I would rather give orders than take them.
28. I would like to be a deep-sea diver.
29. I have little self-confidence.
30. I feel like life is just passing me by.
31. I am an ambitious person.
32. I frequently do things on impulse.
33. I am interested in science.
34. I am a happy person.
35. I like to give orders and get things moving.
36. I can use a microscope.
37. I understand why stars twinkle.
38. Life is no fun when you play it safe.
39. I like to have a schedule and stick to it.
40. Sometimes I enjoy going against the rules.
41. I am not a competitive person.
42. I think I would enjoy having authority over people.
43. In a group, I like to take charge of things.
44. I like challenges.
45. I would like to go mountain climbing.
46. I love the hustle and bustle of city crowds.
47. I would like to be an inventor.
48. I don't care for large, noisy crowds.

Appendix E

EODPI Expectancy Tables

Expectancy of Success by EODPI Score Intervals and Criterion Measure

EOD Course Success

SCORES	PERCENT	25	50	75	100	HIT RATE
17- 24	60.0	XXXXXXXXXXXXXXXXXXXXXXX				6/ 10
25- 29	32.0	XXXXXXXXXXXXX				8/ 25
30- 34	57.4	XXXXXXXXXXXXXXXXXXXXXXX				27/ 47
35- 42	86.7	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				13/ 15

Diving Status

SCORES	PERCENT	25	50	75	100	HIT RATE
17- 24	70.0	XXXXXXXXXXXXXXXXXXXXXXXXXX				7/ 10
25- 29	79.3	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				23/ 29
30- 34	86.6	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				58/ 67
35- 42	94.9	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				37/ 39

EOD Status

SCORES	PERCENT	25	50	75	100	HIT RATE
17- 24	60.0	XXXXXXXXXXXXXXXXXXXXXXX				6/ 10
25- 29	41.4	XXXXXXXXXXXXXXXX				12/ 29
30- 34	70.1	XXXXXXXXXXXXXXXXXXXXXXXXXXXX				47/ 67
35- 42	94.9	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				37/ 39

Appendix F

Descriptive Statistics for EOD Apprentice HPI Test Results

HPI Descriptive Statistics: Apprentice Technicians Passing EOD Training

VARIABLE	MEAN	STD DEV	MINIMUM	MAXIMUM	VALID N
GOOD MEMORY	3.643	1.394	1.000	5.000	112
SCHOOL SUCCESS	2.036	1.078	0.0	3.000	111
MATH ABILITY	2.459	1.400	0.0	4.000	111
READING	2.045	1.485	0.0	4.000	112
SCIENCE ABILITY	4.518	1.382	1.000	6.000	112
CULTURAL TASTE	1.732	1.208	0.0	4.000	112
CURIOSITY	2.241	.738	0.0	3.000	112
INTELLECTUAL GAMES	2.375	1.281	0.0	4.000	112
NOT ANXIOUS	2.125	1.156	0.0	4.000	112
NO SOCIAL ANXIETY	3.866	1.803	0.0	6.000	112
NO GUILT	3.571	1.648	0.0	6.000	112
NOT DEPRESSED	5.545	.670	3.000	6.000	112
NO SOMATIC COMPLAIN	5.437	.928	1.000	6.000	112
CALMNESS	3.170	.793	1.000	4.000	112
SELF CONFIDENCE	2.661	.665	0.0	3.000	112
IDENTITY	4.929	1.431	0.0	6.000	112
SELF-FOCUS	1.946	1.457	0.0	5.000	112
GOOD ATTACHMENT	3.455	1.883	0.0	6.000	112
STRUCTURE / PLANFUL	2.580	1.292	0.0	5.000	112
APPEARANCE	2.982	1.131	0.0	4.000	112
MASTERY / HARDWORK	3.893	1.233	0.0	5.000	112
PERFECT	2.214	1.304	0.0	5.000	112
IMPULSE CONTROL	2.741	1.558	0.0	6.000	112
AVOIDS TROUBLE	5.500	1.600	0.0	7.000	112
EXPERIENCE SEEKING	.848	1.067	0.0	5.000	112
THRILL-SEEKING	.857	1.207	0.0	5.000	112
NOT SPONTANEOUS	2.250	1.151	0.0	4.000	112
GENERATES IDEAS	3.482	1.335	0.0	5.000	112
LEADERSHIP	4.830	1.986	0.0	7.000	112
STATUS	3.652	1.080	1.000	5.000	112
IMPRESSION MANAGEME	2.946	1.476	0.0	6.000	112
COMPETITIVE	4.598	.703	2.000	5.000	112
ENTERTAINING	1.732	1.252	0.0	4.000	112
EXHIBITIONISTIC	2.482	1.495	0.0	5.000	112
LIKES CROWDS	1.937	1.403	0.0	4.000	112
LIKES PARTIES	2.437	1.321	0.0	5.000	112
EXPRESSIVE	2.321	1.344	0.0	5.000	112
EASY TO LIVE WITH	4.625	.796	1.000	5.000	112
EVEN TEMPERED	3.857	1.576	0.0	6.000	112
CARING	3.616	.713	1.000	4.000	112
TRUSTING	1.732	.920	0.0	3.000	112
LIKES PEOPLE	5.223	1.354	0.0	6.000	112
AUTONOMY	2.143	1.222	0.0	4.000	112
INFREQUENT RESPONSE	15.348	.908	12.000	16.000	112
INTELLECTANCE	21.009	5.378	7.000	32.000	112
ADJUSTMENT	33.250	6.245	18.000	43.000	112
PRUDENCE	27.321	6.137	12.000	44.000	112
AMBITION	19.509	3.725	12.000	27.000	112
SOCIABILITY	10.911	4.128	1.000	19.000	112
LIKEABILITY	21.196	3.469	10.000	27.000	112
VALIDITY	15.348	.908	12.000	16.000	112

HPI Descriptive Statistics: Apprentice Technicians Failing EOD Training

VARIABLE	MEAN	STD DEV	MINIMUM	MAXIMUM	VALID N
GOOD MEMORY	3.343	1.462	0.0	5.000	67
SCHOOL SUCCESS	2.000	.937	0.0	3.000	67
MATH ABILITY	2.194	1.510	0.0	4.000	67
READING	1.806	1.480	0.0	4.000	67
SCIENCE ABILITY	4.522	1.260	1.000	6.000	67
CULTURAL TASTE	1.776	1.165	0.0	4.000	67
CURIOSITY	2.149	.783	0.0	3.000	67
INTELLECTUAL GAMES	2.463	1.020	0.0	4.000	67
NOT ANXIOUS	1.716	1.152	0.0	4.000	67
NO SOCIAL ANXIETY	3.866	1.731	0.0	6.000	67
NO GUILT	3.448	1.795	0.0	6.000	67
NOT DEPRESSED	5.209	1.238	1.000	6.000	67
NO SOMATIC COMPLAIN	5.239	1.088	1.000	6.000	67
CALMNESS	2.970	1.101	0.0	4.000	67
SELF CONFIDENCE	2.478	.704	1.000	3.000	67
IDENTITY	4.567	1.616	0.0	6.000	67
SELF-FOCUS	2.015	1.441	0.0	5.000	67
GOOD ATTACHMENT	3.582	1.802	0.0	6.000	67
STRUCTURE / PLANFUL	3.119	1.409	0.0	5.000	67
APPEARANCE	3.104	1.143	0.0	4.000	67
MASTERY / HARDWORK	3.657	1.136	1.000	5.000	67
PERFECT	2.209	1.238	0.0	5.000	67
IMPULSE CONTROL	2.507	1.471	0.0	6.000	67
AVOIDS TROUBLE	5.149	1.672	1.000	7.000	67
EXPERIENCE SEEKING	.851	1.004	0.0	5.000	67
THRILL-SEEKING	.985	1.121	0.0	4.000	67
NOT SPONTANEOUS	1.836	.979	0.0	4.000	67
GENERATES IDEAS	3.627	1.412	0.0	5.000	67
LEADERSHIP	4.866	1.953	0.0	7.000	67
STATUS	3.881	.993	1.000	5.000	67
IMPRESSION MANAGEME	2.985	1.581	0.0	6.000	67
COMPETITIVE	4.433	.821	2.000	5.000	67
ENTERTAINING	1.821	1.313	0.0	4.000	67
EXHIBITIONISTIC	2.627	1.486	0.0	5.000	67
LIKES CROWDS	2.254	1.385	0.0	4.000	67
LIKES PARTIES	2.567	1.384	0.0	5.000	67
EXPRESSIVE	2.567	1.438	0.0	5.000	67
EASY TO LIVE WITH	4.448	.875	2.000	5.000	67
EVEN TEMPERED	3.522	1.778	0.0	6.000	67
CARING	3.433	.743	1.000	4.000	67
TRUSTING	1.657	.978	0.0	3.000	67
LIKES PEOPLE	4.985	1.441	0.0	6.000	67
AUTONOMY	1.582	1.281	0.0	4.000	67
INFREQUENT RESPONSE	14.881	1.387	10.000	16.000	67
INTELLECTANCE	20.254	5.963	5.000	32.000	67
ADJUSTMENT	31.507	7.528	13.000	45.000	67
PRUDENCE	27.000	6.443	13.000	38.000	67
AMBITION	19.791	4.143	8.000	28.000	67
SOCIABILITY	11.836	4.653	1.000	23.000	67
LIKEABILITY	19.627	4.208	8.000	27.000	67
VALIDITY	14.881	1.387	10.000	16.000	67

Appendix G

EOD Apprentice Potential Inventory

(EODAPI)

EOD Apprentice Potential Inventory

(EODAPI)

1. As a child I was always reading.
2. When I'm in a group I usually do what others want.
3. I remember phone numbers easily.
4. I want more of everything.
5. I don't care if others like the things I do.
6. It bothers me when my daily routine is interrupted.
7. I want to be the best at everything I do.
8. I don't like things to be uncertain and unpredictable.
9. I never know what I will do tomorrow.
10. I am seldom tense or anxious.
11. The future seems hopeless to me.
12. I want people to look up to me.
13. I have a strong desire for success in the world.
14. In school, I memorized facts quickly.
15. I won't start a project unless I know how it will turn out.
16. I read at least ten books a year.
17. I have a large vocabulary.
18. When I was in school I gave the teachers a lot of trouble.
19. It is always best to stick with a plan that works.
20. I have been in trouble for drinking too much.
21. I would rather read than watch tv.
22. I worry alot.
23. I get depressed a lot.
24. As a youngster in school I was suspended for my behavior.
25. Other people's opinions of me are not important.

26. Planning things in advance takes the fun out of life.
27. It often seems that my life has no meaning.
28. I get tired of doing things the same old way.
29. I have never been in trouble with the law.
30. I often feel anxious.
31. When I was in school, I was sometimes sent to the principal because of my behavior.
32. I have been in trouble for experimenting with marijuana or other drugs.
33. I feel like life is just passing me by.
34. I am a fast reader.
35. I am a good speller.
36. I like not knowing what tomorrow will bring.
37. I used to steal sometimes when I was a kid.
38. I rarely get anxious about my problems.
39. I have a good memory.
40. I like to have a schedule and stick to it.
41. Nothing good ever happens to me.
42. I want to be an important person in my community.
43. I don't really care what other people think of me.
44. I am a happy person.